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SMALL COMMERCIAL BUILDING ENERGY RETROFIT

DESIGN WORKSHOP (N.B.) LTD.

Moncton, N.B.

CREDA Project # 2044

February, 1985

Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

Conservation & Renewable
Energy Division
Energy Secretariat
P.O. Box 6000
Fredericton, N.B.
E3B 5H1
(506) 453-3897

Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

Division des économies d'énergie
et des énergies renouvelables
Secrétariat à l'énergie
C.P. 6000
Fredericton, N.-B.
E3B 5H1
(506) 453-3897

D I S C L A I M E R

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1.0 EXECUTIVE SUMMARY

The offices of Design Workshop (N.B.) Ltd. were retrofitted to demonstrate the feasibility of converting residential buildings to commercial office space and making them energy efficient.

The project has been successful in reducing energy consumption in the building, lowering overall electrical consumption from 338 kWh/sq.m (31.4 kWh/sq. ft.) to 95.8 kWh/sq.m (8.9 kWh/sq.ft). This level is competitive with the most modern commercial space.

1.0 RESUME

Les offices de Design Workshop (N.B.) Ltd. on été refecté pour démontrer l'économie d'énergie realisable en remettant une vielle residence à neuf lors de sa transformation en locaux à usage commercial.

La technologie demontrée fut un succès en abaissant la consommation d'énergie. La consommation d'électricité descendue de 338 kWh/m^2 (31.4 kWh/pi^2) à 95.8kWh/m^2 (8.9 kWh/pi^2). Ceci est très respectable en comparant à des édifices modernes.

2.0 INTRODUCTION AND BACKGROUND

Located one block from the busy, commercial area of Moncton stands an impressive house with a large Queen Anne style turret. The home at 67 Botsford Street is presently owned by Design Workshop (N.B.) Ltd. and it serves as the design studios and business location for the firm of Architects and Planners.

The plan of the home is square, two and one-half storey, and it stands on a full basement area. It is a wooden structure with horizontal plank and it has grey clapboard sheathing. The interior of the home is in excellent condition, retaining the atmosphere of days gone by. During the 1950's the house suffered a fate which seems prevelent among the older, larger homes. It was divided into two flats, 65 and 67 Botsford Street. However, no trace remains of the home being divided.

Recycling of older buildings has become more and more economic as the capital cost of new construction continues to rise. The purpose of this project was to demonstrate the economics of energy efficient retrofit of an old residential structure to commercial office space. It illustrates the viability of recycling of such buildings in the downtown commercial area of a town or city and may encourage the preservation of older architecture and the conservation of energy.

3.0 GENERAL DESCRIPTION OF THE DEMONSTRATION

For any structure to be truly efficient, it must have the following:

1. A good thermal building envelope with minimal air leakage.
2. High levels of insulation in the walls and roof.
3. An energy efficient heating system.
4. Building occupants who are energy conscious.

Furthermore, energy consumption in a building can be divided among three major items:

1. Heating/Cooling of the building envelope.
2. Lighting and Miscellaneous Power
3. Domestic Hot Water

This project addressed all three of the above areas.

3.1 BUILDING ENVELOPE

The walls and roof of this structure had been previously insulated. To ensure that an adequate thermal barrier existed, thermographic photography of the exterior walls was undertaken and various insulation deficiencies were discovered. The voids occurred around window frames and construction joints for the most part and were subsequently corrected by installing additional insulation and air sealing.

The roof was previously insulated at the attic floor level. During the energy retrofit, the building owner decided to finish the attic space and utilize it as additional office space. The roof was then insulated with Fiberglas batts and covered with vapour barrier and drywall.

The insulation levels achieved were:

Walls - RSI 3.5 (R20)

Roof - RSI 7.0 (R40)

Basement walls - RSI 3.5 (R20)

To preserve the architectural character of the building's interior spaces, it was decided to install two small air/air heat pump systems; one for the basement and main floor; the other for the second floor and attic space. With two separate systems, it was not necessary to install complicated ductwork systems from main to second floor.

Two systems installed are the air/air type and were selected as the most practical for retrofit of older residential buildings within an urban area. Each of the heat pumps is provided with an auxillary electric heating coil for supplementary heat.

3.2 LIGHTING AND MISCELLANEOUS POWER

Where possible task lighting was implemented in lieu of an overall high level lighting. Workstations in general were situated to make use of natural lighting. In those areas

requiring high illumination, modern flourescent fixtures were used.

3.3 DOMESTIC HOT-WATER

In an effort to overcome the stand-by losses inherent in a conventional hot water tank, instantaneous water heaters were used. These compact units are situated at the point-of-use and heat the water only on demand.

4.0 COST/BENEFIT ANALYSIS

I. PROJECT CAPITAL COST SUMMARY

The cost breakdown for this project is listed below:

Heat Pump Systems	$11,140.00
Insulating, Air Sealing, Etc.	3,025.00
Electrical & Plumbling	2,685.00
	$16,850.00
Metering Equipment/Performance Monitoring	$ 6,900.00
Information Transfer	6,500.00
Project Total	$30,250.00
CREDA Funding	23,130.00
Owner's Funding	$ 7,120.00

II. PAYBACK ANALYSIS (FOR DUPLICATE PROJECT)

Capital Cost	$16,850.00
Saving per year (see Appendix A)	1,618.00
Simple Payback	$\frac{\$16,850}{\$\ 1,618}$ = 10.4 years

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The energy demonstration project at 67 Botsford Street has successfully shown that older residential structures can be economically converted to first class office space and can be very energy efficient. The overall energy consumption has proven to be approximately 60% of modern commercial office buildings.

5.2 RECOMMENDATIONS

As a result of this demonstration project, several comments can be made.

- that air/air heat pumps are a practical means of providing heating and cooling for older residential buildings.
- that air leakage control is of primary importance when retrofitting older buildings.
- that older residential buildings be converted to office space in downtown cores.

APPENDICES

APPENDIX "A"

Basis for Calculating Cost Savings

The following table summarizes energy consumption before and after the energy retrofit:

	March 1982 - March 1983				March 1983 - March 1984	
	Oil	Elect.	Equiv. KWH	KWH Sq.Ft.	Elect.	KWH/Sq.Ft.
Heating/ Cooling	7093	---	77739	27.7	24,912	6.9
Lighting Misc. Power	---	10430	10430	3.7	5,880	1.6
Domestic Hot Water	incl above	---	---	---	1,448	0.4
			88169	31.4*	32,240	8.9**

* for 260m^2 (2800 sq. ft.) of space
** for 334 m^2 (3600 sq. ft.) of space

Before conversion, the building energy costs were $3,215.00 for combined oil and electricity costs. The building at that time had only 260m^2 (2800 sq. ft.) of usable space.

For purposes of calculating an annual saving this figure was escalated to $4,133.00 to reflect the energy costs had the full 3600 st. ft. been available before conversion.

Considering costs of $2,515.00 for energy after conversion, effective annual saving of ($4133 - $2515) = $1618 has been achieved.

APPENDIX B

RECORD OF ENERGY CONSUMPTION

	Main Electrical Meter	Heat Pump #1	Condenser #1	Heat Pump #2	Condenser #2	DHW Heater
March 1983	3130		954	1238	456	
April	1740	765	143	47	69	85
May	1590	38	343	71	73	232
June	1380	110	84	277	538	139
July	1610	173	58	233	1183	102
August	1560	94	26	50	136	145
September	1400	1035	528	165	400	118
October	2050	148	914	31	251	160
November	3340	562	826	1158	645	215
December	5480	1420	1095	695	38	68
January 1984	6220	2381	976	390	679	137
February	4740	2299	446	198	375	47
	32240 KWH	9125 KWH	6393	4551	4834	1448

APPENDIX "C" - PHOTO